$ET150396370US$

System and Method for Distributing Proximity
Information Using a Two-Tiered Bootstrap Process

RELATED APPLICATIONS

5   This application is related to the following co-pending U.S. Patent Application filed on the same day as the present application and having the same inventor and assignee: "System and Method for Managing Information Exchange Using Strip Information Elements," (Docket No. AUS9-2001-0562-US1) by Barillaud and assigned to the IBM

10   Corporation.

BACKGROUND OF THE INVENTION

1. Technical Field

        The present invention relates in general to a system and method for exchanging data between computing devices.

15   More particularly, the present invention relates to a system and method for using an adaptable agent for downloading information to a handheld device in conjunction with the admittance of a user to an event.

2. Description of the Related Art

20   In the pervasive device environment, handheld devices communicate with external entities. When the information exchange requires more than a single and simple communication exchange, one of the best approaches to solve the problem is to have an agent within the handheld

25   computing device that takes care of the communication exchange. An agent is a program that performs information gathering or processing task in the background. Typically,

an agent is given a very small and well-defined task. Tasks involved in the communication exchange include requesting and receiving the proper information content type. Examples of information content are text, non-real time

5   video, real time video, and music. Bandwidth resources are wasted when a service provider sends text and video information to a device that is capable of processing text, but not video. Another varying factor in handheld devices is the screen. Many pagers have a small, monochrome

10   screen, while laptop computers, however, often have larger, color screens. Bandwidth resources are wasted when a service provider sends information to the paging device that the paging device is not able to display properly. Unfortunately, there is no unique, common agent able to

15   handle the different types of communication for the different types of information content.

The type and amount of electronic devices for information exchange are increasing and improving at an exceptional rate due to the investments in technology

20   research. Mobile telephones today, for example, are able to communicate on multiple frequencies as well as multiple air interfaces (analog, CDMA, TDMA, etc.). Mobile phones are also useful for more than just for phone conversations. For example, many mobile telephones can access the Internet

25   or a host of services that provide information. Other handheld communication devices also have greatly improved capabilities in comparison to devices offered only a few years ago. Pagers can now transmit messages as well as access Internet information. Many Personal Digital

30   Assistants (PDA's) have wireless connections that allow the PDA to send and receive wireless data and access computer

networks, such as the Internet. With the increasing quantity and quality of portable electronic devices, a challenge is to develop an agent that is able to support the many devices that are available, as well as devices

5   that are soon to be available.

What is needed, therefore, is an agent that is adaptable to the constraints and features provided in any number of possible handheld devices.

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SUMMARY

It has been discovered that by introducing a two-step agent loading process, an agent can adapt to a targeted handheld device. A bootstrap agent is first loaded in the handheld device. The bootstrap agent manages the downloading of a second, more specialized agent that is based on both the characteristics of the handheld device and the services to which the user has subscribed. Both agents have functionality to monitor the operation of the other agent. In this manner, if one agent fails, the other agent restarts the failed agent.

The agents control the information that is shown to the user. Event ID's are attached to information being transmitted by the service provider. An event ID identifies an event that corresponds to downloadable information. The agent compares the event IDs with the ID of the event to which the user has subscribed. The agent displays information that matches the ID of the event to which the user is subscribed. Information types are managed by the agents. In this manner, the agent does not request video information if the handheld device is not capable of displaying it or if the subscriber has not subscribed to a video service. The agents can also be time limited and removed after an event takes place. The time limit is extendable if the service provider chooses.

The foregoing is a summary and thus contains, by necessity, simplifications, generalizations, and omissions of detail; consequently, those skilled in the art will appreciate that the summary is illustrative only and is not

intended to be in any way limiting. Other aspects, inventive features, and advantages of the present invention, as defined solely by the claims, will become apparent in the non-limiting detailed description set forth

5 below.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention may be better understood, and its numerous objects, features, and advantages made apparent to those skilled in the art by referencing the accompanying drawings. The use of the same reference symbols in different drawings indicates similar or identical items.

Figure 1 is high level diagram of a Interactive Proximity Service Architecture;

Figure 2 is a diagram of a bootstrap agent and lifecycle control agent being downloaded into a handheld device;

Figure 3 is a diagram of Strip Information Elements being transmitted from a Strip Distribution Engine;

Figure 4 shows the field information included in a Strip Information Element;

Figure 5 is a high level flowchart showing an agent loading process and information exchange;

Figure 6 is a flowchart showing the Bootstrap Agent loading process;

Figure 7 is a flowchart showing the Lifecycle Control Agent Loading process;

Figure 8 is a flowchart showing the Bootstrap Agent and Lifecycle Control Agent monitoring each other.

Figure 9 is a flowchart showing information exchange between the handheld device and service provider;

Figure 10 is a flowchart showing a Strip Information Element being received and processed; and

Figure 11 is a block diagram of an information handling system capable of implementing the present invention.

DETAILED DESCRIPTION

The following is intended to provide a detailed description of an example of the invention and should not be taken to be limiting of the invention itself. Rather,

5   any number of variations may fall within the scope of the invention which is defined in the claims following the description.

Figure 1 is high level diagram of an Interactive Proximity Service Architecture (IPSA). The core function

10 of Interactive Proximity Service Architecture **100** is to transmit data from a single or multiple websites to a variety of wireless devices sharing the same proximity environment. The transmission of data is based not only on service provider actions, but also on user requests.

15 Examples of data transmitted via the service include video replay and latest statistics of a player that just hit a home run during a baseball game, or audio excerpts of a painter's biography as the visitor is looking at his painting in a museum. Interactive Proximity Service

20 Architecture **100** can be configured to communicate with handheld devices for a single event or for multiple events. For example, a baseball game may have one IPSA, and a football game in the same proximity may have a separate IPSA. As those skilled in the art can appreciate, a single

25 IPSA can also be configured to support and communicate with multiple events (i.e. one IPSA supporting both a baseball game and a football game).

A subscriber carries cell phone **110**, personal digital assistant (PDA) **130**, or other handheld device **120** to an

event.   Examples   of   other   handheld   devices   includes
electronic   items   such   as   a   laptop   computers.   The
subscriber   enters   an   event   and   the   handheld   devices
communicate   with   communication   front   end   **105.**

5   Communication   front   end   **105**   can   be   an   infrared   port,   a
wireless   system   such   as   a   cellular   or   paging   network.
Communication   front   end   **105**   analyzes   the   signals   from   the
handheld   devices,   and   passes   the   information   requests   to
web   server   **140.**   For   example,   information   requests   can   be

10   in   Hyper   Text   Transfer   Protocol   (HTTP)   format.   Web   Server
140   communicates   with   Servlet   Engine   **150**   and   Transcoding
Application   **160.**   Transcoding   Application   **160**   ascertains
the   type   of   device   accessing   the   site   and   applies   the
proper   style   to   display   the   data.   For   example,   the   screen

15   size   and   resolution   of   the   device   are   used   in   determining
the   proper   style   to   display   the   information.   Web   server
HTTP   requests   trigger   Java   servlets   in   servlet   engine   **150.**
Servlet   engine   **150**   accesses   database   **170**   for   the   requested
information,   such   as   downloadable   video   or   text   content.

20   Database   **170**   includes   basic   information   and   may   be   updated
with   new   static   information   from   non-real   time   data
provider   **180**   or   real-time   information   from   real-time   data
provider   **190.**   Database   **170**   information   includes   formats
such   as   text,   audio,   and   video.

25   **Figure 2**   is   a   diagram   of   a   bootstrap   agent   and
lifecycle   control   agent   being   downloaded   into   a   handheld
device.   An   Agent   at   the   Gate   concept   means   that   every   time
a   customer   attends   an   event   (sports   game,   museum,
conference,   etc.)   a   unique   agent   for   the   event   downloads   to

30   his   handheld   device.   The   process   is   performed   in   two   steps
whereby   a   Bootstrap   Agent   (BA)   is   downloaded   to   the

customer handheld device through the infrared port and the bootstrap agent in turn downloads the Lifecycle Controlled Agent (LCA) through a faster wireless link. Both BA and LCA have functionality that allows a mutual monitoring so

5   if one agent fails, the other reloads and restarts the one which failed.

When customer **220** arrives at an event that includes Interactive Proximity services from Service Provider **200**, customer **220** downloads bootstrap agent **225** from the service

10 providers' (**200**) infrared port **205**. Bootstrap agent **225** is downloaded into customers' handheld device **250** through customer's Infrared port **255**. The primary purpose of the Bootstrap agent is to download the Lifecycle Controlled Agent (LCA). The bootstrap agent includes transfer and

15 security functionality such as event identifier **230**, monitoring functionality **235**, and security enforcements **240**. Event Identifier **230** is unique and is used as a discriminator so that there is no overlap between information exchanged in different events that happen in

20 the same proximity range at the same time. Monitoring **235** and security enforcement **240** are used to monitor the proper operation of the Lifecycle Controlled Agent and to reload the LCA if the LCA stops functioning. Once the bootstrap agent is loaded into handheld proximity application **260**,

25 the bootstrap agent sends request **270** through handheld device wireless port **265** to download the lifecycle control agent. When service providers wireless station **210** receives request **270**, wireless station transmits lifecycle control agent **275** that includes service time to live (STTL)

30 **280** and class of service **285**. Service time to live **280** is part of the security information with a main purpose of

invalidating access to the services and to removing the agent after a certain period of time. This parameter may be upgraded on the fly during the event to meet specific service requirements. For example, the STTL could be

5   extended for a football game that requires an overtime period to conclude. Or a museum can extend the STTL over several days according to the subscription taken by the customer. Class of service (COS) **285** represents different levels of services to which a customer can subscribe. The

10   COS is defined by the event producer and may be different over the time even for the same type of event. Examples of COS are Audio, Text only, Video, and Video+. For Text only COS, the subscriber is allowed to receive and to request information in text format. For Audio, the subscriber

15   receives all audio that is broadcast during the event. For Video COS, the subscriber receives all video that is broadcast during the event. For Video+ COS, the subscriber can interactively query additional video functionality such as slow motion replay or specific camera angles.

20   **Figure 3** is a diagram of Strip Information Elements being transmitted from a Strip Distribution Engine. Strip Distribution Engine **300** sends strips **310** to handheld devices **320** for a particular event. Strips **310** do not include all the data but includes elements necessary to

25   retrieve, format, and display the information. The Information Proximity Service Architecture sends SIEs instead of pushing the whole information from the servers to the handheld devices in order minimize bandwidth usage. Agent **340** is internal to the handheld device and analyzes

30   the strips that are sent to a handheld. Agent **340** authenticates the strip by analyzing the strips' Event

Identifier to prevent distribution of unauthorized information. After the security checking is completed, the strip is under the control of the local agent that scans the different fields and makes determinations according to
5   the content of the fields. When the user wants to download data, the user sends request **350** to retrieve a particular piece of data. For example, request **350** can be for multimedia data such as video. Strip Distribution Engine sends multimedia data **360** to the handheld device.
10 Multimedia information can be obtained from database **390** which can include video plus hypertext links. Data can also be obtained from database **380** which may contain video, or database **370** which may only contain text information.

Figure 4 shows the field information in a Strip
15 Information Element. Strip information Element (SIE) **400** contains multiple fields that allow the local agent and service provider to communicate to each other. The first field is Execution Field **410**. Execution Field **410** includes information that informs the handheld device whether data
20 may be retrieved immediately or on user request. When immediate **414** is selected, the local agent initiates the connection of the wireless station to download the information upon receipt of the SIE. When on request **418** is selected, the local agent waits until the user asks for
25 the specific information before downloading it. For example, live video information may be downloaded immediately, while replay video may be on user request.

Lifecycle Field **420** includes information that determines whether the information may be kept after been
30 processed by the local agent. When "keep" option **424** is selected, the user is allowed to keep the data that has

been transferred to his handheld device. This field can be set up on a per strip element basis, allowing strict control over what the user is able to keep. For example, due to intellectual property rights limitations, this field

5   could be set up to a value that prevents duplication of the retrieved information that contains intellectual property, but allow the user to keep information that does not contain intellectual property. Another example is that some data are transient at server level, and make it not

10 possible to access the data after a certain period of time. In this case, the lifecycle field will also set up to a value that prevents the local agent to try to access the data. When "discard" option **426** is selected, the downloaded data is discarded from the user's device upon

15 completion of the event. When conditional remove **428** is selected, data may also be accessed multiple times during a certain condition. For example, data may be accessed multiple times during a sporting event, but the data is discarded once the event is over.

20   Navigation Field **430** includes information for the handheld device to logically store the strip information elements. As the SIE's are downloaded to the handheld device, they are stored in a way that allows an easy access according to a dynamic navigation scheme. Since the

25 display sequence at time *t* may differ from the display sequence at time *t+1*, each SIE carries information about the navigation. This information represents the location of the information in a display tree. When a new SIE is received, it is placed in a specific location in the tree

30 and as the dynamic structure of the tree evolves in time, the position of the SIE moves across the tree. When insert

432 is selected, the SIE is inserted between the specified SIE's. When remove **434** is selected, the SIE is removed from the display tree. When next **436** is selected, the SIE is stored in the next available location. When previous

5 **438** is selected, the SIE is stored in the location prior to the last SIE in the display tree.

Persistence Field **440** includes information that specifies what kind of repeated requests are expected for the piece of information. The user can select a

10 persistence option that determines where and how the information is stored. The persistence can be local on the handheld device or remote. If local **442** is selected, the persistence is stored on the handheld device. If remote **444** is selected, persistence is stored on a remote device.

15 Two example fields shown for a remote device are printer **446** and disk **448**. If printer **446** is selected, persistence comes from an external printer. If disk **448** is selected, persistence is stored on a nonvolatile storage device, such as a magnetic disk device.

20 Security Field **450** includes information that pertains to the security of the information being transferred. Security Field **450** includes event ID **458** which is the unique identifier that is used as a first protection level. The event id allows the user to receive information for the

25 particular event subscribed to, and not to receive information from a nearby event that has a different event id. Security Field **450** also includes key **454** which is a key from a public/private encryption key pair used by the local agent to protect sensitive data exchanged between the

30 server and the client.

Configuration Field **460** includes information such as Service Time To Live (STTL) **464,** Server information **466,** and transcoding information **468.** STTL **464** is used by the local agent to release further access to services once time

5   has expired. Server information **466** includes information that can be negotiated by the handheld devices, such as bandwidth information, available protocols, and status information. Transcoding information **468** includes information about how the data is displayed based on the

10 screen size and resolution of the handheld device.

Id Field **470** includes Strip Information Element (SIE) Identifier **475.** SIE **475** is a unique identifier for SIE **400.** SIE Identifier **475** is different from the Event Identifier in that each SIE is assigned with a unique

15 identifier that is mainly used to uniquely identify the data in the navigation tree.

Description Field **480** includes description information about the corresponding content. The description includes the address of the content on the server, such as URL **482.**

20 The description can also include data **484** about the content, such as any additional cost to download the corresponding content which may be in addition to any subscription fees paid by the user. Description **480** also includes text description **486** which includes a short

25 description that can be displayed to the user in order for the user to determine whether he wants to download the corresponding content.

Figure 5 is a high level flowchart showing an agent loading process and information exchange. Processing

30 commences at **500,** whereupon a subscriber enters an area

(step **510**), such as an event location.   A determination is
made as to whether the subscriber is new or is already a
registered subscriber (decision **520**).   If the subscriber is
not new, decision **520** branches to "No" branch **524** whereupon

5   a Lifecycle Control Agent is requested (step **550**).   For
example, a subscriber can have an annual subscription to a
museum, and already be registered at the museum and already
have a bootstrap agent loaded in his handheld device.   On
the other hand, if the subscriber is new, decision **520**

10   branches to "yes" branch **528** whereupon a subscription is
activated   for   the   event   (step   **530**).   Subscription
activation may also include receiving payment information,
such as a credit card number, from the user and charging
the user the corresponding subscription fee.   After the

15   subscription activates, a bootstrap agent loads into the
subscribers handheld device (pre-defined process block **540**,
see **Figure 6** for further details).   After the bootstrap
agent loads, the bootstrap agent requests a Lifecycle
Control Agent (LCA) (step **550**) through handheld wireless

20   port **554**.   The LCA may be loaded if the handheld device
does not yet have an LCA or if it is determined that an LCA
currently loaded on the handheld device is outdated and
needs to be upgraded with a new LCA version.   The handheld
wireless port sends the request to system wireless port **558**

25   and receives the Lifecycle control agent in the same
manner.   A determination is made as to whether the LCA has
been received (decision **560**).   If the LCA has not yet been
received, decision **560** branches to "No" loop **554** whereupon
processing loops back and waits for the LCA.   On the other

30   hand, when the LCA is received, decision **560** branches to
"Yes" branch **558** whereupon the LCA loads (pre-defined
process block **570**, See **Figure 8** for further details).   The

LCA is used for downloading content corresponding to the subscribed event. Agent Monitoring also commences (pre-defined process block **575,** see **Figure 8** for further details) whereupon the bootstrap agent and the Lifecycle

5 Control Agent each monitor each other and restart one another in the event of a failure. The subscriber is now ready for information exchange (pre-defined process block **580,** See **Figure 9** for further details) during which time the Lifecycle Control Agent is used to download various

10 content associated with the subscribed event. When information exchanges has completed, for example at the end of the event, processing terminates at **590.**

Figure 6 is a flowchart showing the Bootstrap Agent loading process. Processing commences at **600,** whereupon

15 the handheld receives a bootstrap agent (step **610**) through handheld Infra Red (IR) port **620.** Handheld IR port **620** receives the bootstrap agent from system IR port **630.** Once the bootstrap agent is received, the bootstrap agent is initialized (step **640**) and Event Identifier is stored (step

20 **650**) in Handheld Proximity Application **660.** Event ID is unique in time and space and is used as a discriminator to assure that there is no overlap between information exchanged in different events that happen in the same proximity range at the same time. Bootstrap agent security

25 settings are loaded in handheld proximity application **660** (step **670**) along with the Lifecycle control agent monitor (step **680**). The security settings and LCA monitor are used to ensure proper operation of the LCA. If the LCA is determined to be inoperable when it should be operational,

30 the bootstrap agent restarts the LCA (see **Figure 8** for further details). After the bootstrap agent information is

loaded into handheld proximity application **660,** processing returns at **690.**

Figure **7** is a flowchart showing the Lifecycle Control Agent Loading process. Processing commences at **700,** whereupon the Lifecycle Control Agent (LCA) is initialized (step **710**). Class of Service (COS) information is retrieved from the LCA (step **720**) and loaded into Handheld Proximity Application **730.** Examples of COS are text, video, and video plus. A determination is made as to whether the handheld is capable of the Class of Service (decision **740**). For example, if the Class of Service is video, the handheld should have the capability of playing video. If the handheld is not capable of the COS, decision **740** branches to "No" branch **744** whereupon a error is returned (step **750**) and processing returns at **760.** On the other hand, if the handheld is capable of the COS, decision **740** branches to "Yes" branch **748** whereupon the bootstrap agent monitor is loaded (step **770**). The bootstrap agent monitor is used to ensure the proper operation of the LCA. If the bootstrap agent is determined to be inoperable when it should be functioning properly, the LCA restarts the bootstrap agent. Service time to live is loaded (step **780**) into timer **735** that tracks how much time is remaining for the Lifecycle Control Agent to be active and processing returns at **790.**

Figure **8** is a flowchart showing the Bootstrap Agent and Lifecycle Control Agent monitoring each other. Agent monitoring commences at **800,** whereupon the Lifecycle Control Agent (LCA) status is retrieved (step **810**) from handheld proximity application **820.** The LCA status includes information about whether the LCA is functioning properly.

A determination is made as to whether the LCA is active and functioning properly (decision **830**). If the LCA is not functioning properly, decision **830** branches to "No" branch **835** whereupon the LCA is restarted (pre-defined process

5   block **840,** See **Figure 7** for further details). On the other hand, if the LCA is functioning properly, decision **830** branches to "Yes" branch **845** whereupon the bootstrap agent status is retrieved (step **850**) from handheld proximity application **820.** A determination is made as to whether the

10   Bootstrap agent is functioning properly (decision **860**). If the bootstrap agent is not functioning properly, decision **860** branches to "No" branch **865** whereupon the BA is restarted (pre-defined process block **870,** See **Figure 6** for further details). On the other hand, if the BA is

15   functioning properly, decision **860** branches to "Yes" branch **875** whereupon a determination is made as to whether the monitoring continues (decision **880**). If the user decides to stop information exchange activity, or the event is over, decision **880** branches to "No" branch **888** whereupon

20   monitoring ends at **890.** On the other hand, if the event is ongoing, decision **880** branches to "Yes" loop **884** whereupon the monitoring process starts over.

Figure 9 is a flowchart showing information exchange between the handheld device and service provider.

25   Processing commences at **900,** whereupon the Service Time To Live (STTL) is retrieved (step **905**) from the handheld proximity application. The STTL includes information about how long the handheld device is allowed to exchange information based on the length of the event.   A

30   determination is made as to whether the STTL is expired (decision **910**).   If the STTL is expired, decision **910**

branches to "Yes" branch **915** whereupon an expiration message is reported (step **920**). The lifecycle control agent is removed from the handheld (step **925**) and processing returns at **930**. On the other hand, if more time remains for the service, decision **910** branches to "No" branch **935** whereupon a request for content is performed at **940**. The user request is sent from handheld wireless port **945** to system wireless port **950**. Service Provider Proximity Application **955** determines the corresponding content and sends it to the handheld device through system wireless port **950**. The requested information is received (step **960**) through handheld wireless port **945** whereupon strip information element (SIE) processing takes place (pre-defined process block **965**, See **Figure 10** for further details). A determination is made as to whether more strips are being processed. If no more strips are being processed, decision **970** branches to "No" branch **975** whereupon processing returns at **985**. On the other hand, if more strips will be processed, decision **970** branches to "Yes" Loop **980** whereupon processing continues.

Figure 10 is a flowchart showing a Strip Information Element (SIE) being received and processed. Processing commences at **1000**, whereupon processing compares event ID's for received SIE **1010** and authorized event ID from handheld proximity application **1015** (step **1005**). A determination is made as to whether the handheld device is authorized to receive the SIE (decision **1020**) based on the event ID comparison. If the handheld device is not authorized to receive the SIE, decision **1020** branches to "No" branch **1022** whereupon the strip is ignored (step **1025**) and processing returns at **1030**. On the other hand, if the handheld device

is authorized to receive the SIE, decision **1020** branches to "Yes" branch **1024** whereupon the received SIE is stored in handheld proximity application **1015** (step **1035**). The SIE Execution field is retrieved at **1040** from handheld

5   proximity application **1015**. The execution field includes information as to whether the data should be retrieved immediately or upon a user request. For example, live video information may be downloaded immediately, while replay video may be performed in response to a user

10 request. A determination is made as to whether the data should be retrieved immediately or on user request (decision **1045**). If the data is to be retrieved immediately, decision **1045** branches to "Yes" branch **1049** whereupon the SIE URL location is retrieved and the data is

15 downloaded from Service Provider Proximity Application (**1060**) and the downloaded data is displayed on the display screen (step **1055**). On the other hand, if the data is downloaded on user request, decision **1045** branches to "No" branch **1047** whereupon processing waits for a user request

20 (step **1050**). When the user requests the data, processing continues from step **1050** whereby the SIE URL location is retrieved and the data is downloaded from Service Provider Proximity Application (**1060**) and the downloaded data is displayed on the display screen (step **1055**). The lifecycle

25 field is retrieved at step **1060** which includes information as to whether the data can be stored after viewing, or if the data is discarded after viewing. For example, data that is readily available on the Internet, like a player's statistics, may be stored on the subscribers handheld

30 device after the event. A determination is made as to whether the data is storable after viewing (decision **1065**). If the data is not storable, decision **1065** branches to "No"

branch **1067** whereupon the data is removed after viewing (step **1070**). On the other hand, if the data can be stored after viewing, decision **1065** branches to "Yes" branch **1069** whereupon the data is stored if the user requests (step

5   **1075**), and processing returns at **1080**.

Figure 11 illustrates information handling system **1101** which is a simplified example of a computer system capable of performing the server and client operations described herein. Computer system **1101** includes processor **1100** which

10   is coupled to host bus **1105**. A level two (L2) cache memory **1110** is also coupled to the host bus **1105**. Host-to-PCI bridge **1115** is coupled to main memory **1120**, includes cache memory and main memory control functions, and provides bus control to handle transfers among PCI bus **1125**, processor

15   **1100**, L2 cache **1110**, main memory **1120**, and host bus **1105**. PCI bus **1125** provides an interface for a variety of devices including, for example, LAN card **1130**. PCI-to-ISA bridge **1135** provides bus control to handle transfers between PCI bus **1125** and ISA bus **1140**, universal serial bus (USB)

20   functionality **1145**, IDE device functionality **1150**, power management functionality **1155**, and can include other functional elements not shown, such as a real-time clock (RTC), DMA control, interrupt support, and system management bus support. Peripheral devices and

25   input/output (I/O) devices can be attached to various interfaces **1160** (e.g., parallel interface **1162**, serial interface **1164**, infrared (IR) interface **1166**, keyboard interface **1168**, mouse interface **1170**, and fixed disk (HDD) **1172**) coupled to ISA bus **1140**. Alternatively, many I/O

30   devices can be accommodated by a super I/O controller (not shown) attached to ISA bus **1140**.

BIOS **1180** is coupled to ISA bus **1140,** and incorporates the necessary processor executable code for a variety of low-level system functions and system boot functions. BIOS **1180** can be stored in any computer readable medium,

5   including magnetic storage media, optical storage media, flash memory, random access memory, read only memory, and communications media conveying signals encoding the instructions (e.g., signals from a network). In order to attach computer system **1101** to another computer system to

10   copy files over a network, LAN card **1130** is coupled to PCI bus **1125** and to PCI-to-ISA bridge **1135.** Similarly, to connect computer system **1101** to an ISP to connect to the Internet using a telephone line connection, modem **1175** is connected to serial port **1164** and PCI-to-ISA Bridge **1135.**

15   While the computer system described in **Figure 11** is capable of executing the invention described herein, this computer system is simply one example of a computer system. Those skilled in the art will appreciate that many other computer system designs are capable of performing the

20   invention described herein.

One of the preferred implementations of the invention is an application, namely, a set of instructions (program code) in a code module which may, for example, be resident in the random access memory of the computer. Until

25   required by the computer, the set of instructions may be stored in another computer memory, for example, on a hard disk drive, or in removable storage such as an optical disk (for eventual use in a CD ROM) or floppy disk (for eventual use in a floppy disk drive), or downloaded via the Internet

30   or other computer network. Thus, the present invention may

be implemented as a computer program product for use in a computer. In addition, although the various methods described are conveniently implemented in a general purpose computer selectively activated or reconfigured by software,

5   one of ordinary skill in the art would also recognize that such methods may be carried out in hardware, in firmware, or in more specialized apparatus constructed to perform the required method steps.

While particular embodiments of the present invention

10   have been shown and described, it will be obvious to those skilled in the art that, based upon the teachings herein, changes and modifications may be made without departing from this invention and its broader aspects and, therefore, the appended claims are to encompass within their scope all

15   such changes and modifications as are within the true spirit and scope of this invention. Furthermore, it is to be understood that the invention is solely defined by the appended claims. It will be understood by those with skill in the art that if a specific number of an introduced claim

20   element is intended, such intent will be explicitly recited in the claim, and in the absence of such recitation no such limitation is present. For a non-limiting example, as an aid to understanding, the following appended claims contain usage of the introductory phrases "at least one" and "one

25   or more" to introduce claim elements. However, the use of such phrases should not be construed to imply that the introduction of a claim element by the indefinite articles "a" or "an" limits any particular claim containing such introduced claim element to inventions containing only one

30   such element, even when the same claim includes the introductory phrases "one or more" or "at least one" and

indefinite articles such as "a" or "an"; the same holds true for the use in the claims of definite articles.